CLAIMS

What is claimed is:

1. A drill bit , comprising:

a bit body with a bit central axis and defining a gage diameter;

a first roller cone, attached to said bit body, having a cone shell, a journal axis, a gage curve, a first set of cutting elements that cut to said gage diameter and a second set of cutting elements that cut inside said gage diameter, there being a gage point at the intersection of said gage curve and at least one of said first set of cutting elements;

at least a second roller cone attached to said bit body, having a cone shell, a journal axis , a third set of cutting elements that cut to said gage diameter, and a forth set of cutting elements that cut inside of the gage diameter;

a first nozzle receptacle formed by said bit body and closer to said gage diameter than to said central axis, said first nozzle receptacle forming a first centroid and a first projected fluid path;

a lateral angle for said first projected fluid path defined with respect to a first plane, said first plane being defined by said bit body central axis, and by a first line lying parallel to said bit body central axis and intersecting said first centroid, wherein said first projected fluid path is disposed at an angle of at most a magnitude of six degrees to said first plane; and

a second nozzle receptacle formed by said bit body and closer to said gage diameter than to said central axis, said second nozzle receptacle forming a second centroid and a second projected fluid path;

a lateral angle for said second projected fluid path defined with respect to a second plane, said second plane being defined by said bit body central axis, and by a second line lying parallel to said bit body central axis and intersecting said second centroid, wherein said second projected fluid path is disposed at an angle of at least a magnitude of six degrees to said second plane;

a radial angle for said second projected fluid path defined with respect to at least two bounding lines, said second projected fluid path being directed between an outer gage boundary line and an inside boundary line;

said outer gage boundary line being defined in a viewing plane perpendicular to said second projected fluid path where said outer gage boundary line is perpendicular to the projection of said journal axis for said first roller cone on said viewing plane, and intersects said projected journal axis at a point of projection of an outer gage point on said viewing plane, said outer gage point being disposed at the intersection of said journal axis and a line perpendicular to said journal axis extending through said gage point;

said inside boundary line being defined in said viewing plane where said inside boundary line is perpendicular to said projected journal axis and intersects said projected journal axis at a projection of the inside bounding point on said viewing plane, said inside bounding point being disposed along said journal axis at a distance equal to 20 percent of said gage diameter from said outer gage point toward said bit body central axis.

2. The drill bit of claim 1, wherein

an inner gage boundary line is defined in said viewing plane where said inner gage boundary line is perpendicular to said projected journal axis and intersects said projected journal

axis at a projection of an inner gage point on said viewing plane, said inner gage point being disposed along said journal axis at a distance equal to 3 percent of said gage diameter from said outer gage point toward said bit body central axis and where said second projected fluid path passes between said inner gage boundary line and said inside boundary line.

3. The drill bit of claim 2, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.5" of at least one of said cutting tips on said first cone at its closest.

4. The drill bit of claim 2, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at it closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.4" of at least one of said cutting tips on said first cone at its closest.

5. The drill bit of claim 2, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the cutting elements of said second cone at their closest,

said second projected fluid path being within 0.3" of at least one of said cutting tips on said first cone at its closest.

6. The drill bit of claim 1, wherein

said first projected fluid path is parallel with said bit central axis.

7. The drill bit of claim 3, wherein,

said second projected fluid path is a face normal fluid path.

8. The drill bit of claim 3, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

9. The drill bit of claim 3, wherein,

said second projected fluid path is a projected average fluid path.

10. The drill bit of claim 4, wherein,

said second projected fluid path is a face normal fluid path.

11. The drill bit of claim 4, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

12. The drill bit of claim 4, wherein,

said second projected fluid path is a projected average fluid path.

13. The drill bit of claim 5, wherein,

said second projected fluid path is a face normal fluid path.

14. The drill bit of claim 5, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

15. The drill bit of claim 5, wherein,

said second projected fluid path is a projected average fluid path.

16. The drill bit of claim 1 wherein,

no more than one nozzle receptacle that is closer to the said gage diameter than to said bit axis, resides between any pair of adjacent roller cones on said bit body.

17. A drill bit , comprising:

a bit body with a bit central axis and defining a gage diameter;

a first roller cone, attached to said bit body, having a cone shell, a journal axis, a gage curve, a first set of cutting elements that cut to said gage diameter and a second set of elements that cut inside said gage diameter, there being a gage point at the intersection of said gage curve and at least one of said first set of cutting elements;

at least a second roller cone attached to said bit body, having a cone shell, a journal axis , a third set of cutting elements that cut to said gage diameter, and a forth set of elements that cut inside of the gage diameter;

a first nozzle receptacle formed by said bit body and closer to said gage diameter than to said central axis, said first nozzle receptacle forming a first centroid and a first projected fluid path;

a lateral angle for said first projected fluid path defined with respect to a first plane, said first plane being defined by said bit body central axis, and by a first line lying parallel to said bit body central axis and intersecting said first centroid, wherein said first projected fluid path is disposed at an angle of at most a magnitude of six degrees to said first plane; and

a second nozzle receptacle formed by said bit body and closer to said gage diameter than to said central axis, said second nozzle receptacle forming a second centroid and a second projected fluid path;

a lateral angle for said second projected fluid path defined with respect to a second plane, said second plane being defined by said bit body central axis, and by a second line lying parallel to said bit body central axis and intersecting said second centroid, wherein said second projected fluid path is disposed at an angle of at least a magnitude of eight degrees to said second plane;

a radial angle for said second projected fluid path defined with respect to at least two bounding lines, said second projected fluid path being directed between an outer gage boundary line and an inside boundary line;

said outer gage boundary line being defined in a viewing plane perpendicular to said second projected fluid path where said outer gage boundary line is perpendicular to the projection of said journal axis for said first roller cone on said viewing plane, and intersects said projected journal axis at a point of projection of an outer gage point on said viewing plane, said outer gage point being disposed at the intersection of said journal axis and a line perpendicular to said journal axis extending through said gage point;

said inside boundary line being defined in said viewing plane where said inside boundary line is perpendicular to said projected journal axis and intersects said projected journal axis at a projection of the inside bounding point on said viewing plane, said inside bounding point being disposed along said journal axis at a distance equal to 20 percent of said gage diameter from said outer gage point toward said bit body central axis.

18. The drill bit of claim 17, wherein

an inner gage boundary line is defined in said viewing plane where said inner gage boundary line is perpendicular to said projected journal axis and intersects said projected journal axis at a projection of an inner gage point on said viewing plane, said inner gage point being disposed along said journal axis at a distance equal to 3 percent of said gage diameter from said outer gage point toward said bit body central axis and where said second projected fluid path passes between said inner gage boundary line and said inside boundary line.

19. The drill bit of claim 18, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the tips of the cutting elements of said second cone at their closest , said second projected fluid path being within 0.5" of at least one of said cutting tips on said first cone at its closest.

20. The drill bit of claim 18, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at it closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.4" of at least one of said cutting tips on said first cone at its closest.

21. The drill bit of claim 18, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.3" of at least one of said cutting tips on said first cone at its closest.

22. The drill bit of claim 17, wherein

said first projected fluid path is parallel with said bit central axis.

23. The drill bit of claim 19, wherein,

said second projected fluid path is a face normal fluid path.

24. The drill bit of claim 19, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

25. The drill bit of claim 19, wherein,

said second projected fluid path is a projected average fluid path.

26. The drill bit of claim 20, wherein,

said second projected fluid path is a face normal fluid path.

27. The drill bit of claim 20, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

28. The drill bit of claim 20, wherein,

said second projected fluid path is a projected average fluid path.

29. The drill bit of claim 21, wherein,

said second projected fluid path is a face normal fluid path.

30. The drill bit of claim 21, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

31. The drill bit of claim 21, wherein,

said second projected fluid path is a projected average fluid path.

32. The drill bit of claim 17 wherein,

no more than one nozzle receptacle, that is closer to the said gage diameter than to said bit axis, resides between any pair of adjacent roller cones on said bit body

33. A drill bit, comprising:

a bit body with a bit central axis and defining a gage diameter;

a first roller cone, attached to said bit body, having a cone shell, a journal axis, a gage curve, a first set of cutting elements that cut to said gage diameter and a second set of elements that cut inside said gage diameter, there being a gage point at the intersection of said gage curve and at least one of said first set of cutting elements;

an at least second roller cone attached to said bit body, having a cone shell, a journal axis , and third set of cutting elements that cut to said gage diameter and a forth set of elements that cut inside of the gage diameter;

a first nozzle receptacle formed by said bit body and closer to said gage diameter than to said central axis, said first nozzle receptacle forming a first centroid and a first projected fluid path;

a lateral angle for said first projected fluid path defined with respect to a first plane, said first plane being defined by said bit body central axis, and by a first line lying parallel to said bit body central axis and intersecting said first centroid, wherein said first projected fluid path is disposed at an angle of at most a magnitude of six degrees to said first plane; and

a second nozzle receptacle formed by said bit body and closer to said gage diameter than to said central axis, said second nozzle receptacle forming a second centroid and a second projected fluid path;

a lateral angle for said second projected fluid path defined with respect to a second plane, said second plane being defined by said bit body central axis, and by a second line lying parallel to said bit body central axis and intersecting said second centroid, wherein said second projected fluid path is disposed at an angle of at least a magnitude of ten degrees to said second plane;

a radial angle for said second projected fluid path defined with respect to at least two bounding lines, said second projected fluid path being directed between an outer gage boundary line and an inside boundary line;

said outer gage boundary line being defined in a viewing plane perpendicular to said second projected fluid path where said outer gage boundary line is perpendicular to the projection of said journal axis for said first roller cone on said viewing plane, and intersects said projected

journal axis at a point of projection of an outer gage point on said viewing plane, said outer gage point being disposed at the intersection of said journal axis and a line perpendicular to said journal axis extending through said gage point;

said inside boundary line being defined in said viewing plane where said inside boundary line is perpendicular to said projected journal axis and intersects said projected journal axis at a projection of the inside bounding point on said viewing plane, said inside bounding point being disposed along said journal axis at a distance equal to 20 percent of said gage diameter from said outer gage point toward said bit body central axis.

34. The drill bit of claim 33, wherein

an inner gage boundary line is defined in said viewing plane where said inner gage boundary line is perpendicular to said projected journal axis and intersects said projected journal axis at a projection of an inner gage point on said viewing plane, said inner gage point being disposed along said journal axis at a distance equal to 3 percent of said gage diameter from said outer gage point toward said bit body central axis and where the second projected fluid path passes between said inner gage boundary line and said inside boundary line.

35. The drill bit of claim 34, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.5" of at least one of said cutting tips on said first cone at its closest.

36. The drill bit of claim 34, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at it closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.4" of at least one of said cutting tips on said first cone at its closest.

37. The drill bit of claim 34, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.3" of at least one of said cutting tips on said first cone at its closest.

38. The drill bit of claim 33, wherein

said first projected fluid path is parallel with said bit central axis.

39. The drill bit of claim 35, wherein,

said second projected fluid path is a face normal fluid path.

40. The drill bit of claim 35, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

41. The drill bit of claim 35, wherein,

said second projected fluid path is a projected average fluid path.

42. The drill bit of claim 36, wherein,

said second projected fluid path is a face normal fluid path.

43. The drill bit of claim 36, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

44. The drill bit of claim 36, wherein,

said second projected fluid path is a projected average fluid path.

45. The drill bit of claim 37, wherein,

said second projected fluid path is a face normal fluid path.

46. The drill bit of claim 37, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

47. The drill bit of claim 37, wherein,

said second projected fluid path is a projected average fluid path.

48. The drill bit of claim 33 wherein,

no more than one nozzle receptacle that is closer to the said gage diameter than to said bit axis, resides between any pair of adjacent roller cones on said bit body

49. The drill bit of claim 1 wherein,

said second lateral angle is greater than eight degrees.

50. The drill bit of claim 1 wherein,

said second lateral angle is less than a minus eight degrees.

51. The drill bit of claim 17 wherein,

said second lateral angle is greater than eight degrees.

52. The drill bit of claim 17 wherein,

said second lateral angle is less than a minus eight degrees.

53. The drill bit of claim 33 wherein,

said second lateral angle is greater than eight degrees.

54. The drill bit of claim 33 wherein,

said second lateral angle is less than a minus eight degrees.

55. The drill bit of claim 1, wherein,

said first projected fluid path is a face normal fluid path.

56. The drill bit of claim 1, wherein,

said first projected fluid path is a parallel to nozzle centerline fluid path.

57. The drill bit of claim 1, wherein,

said first projected fluid path is a projected average fluid path.

58. The drill bit of claim 17, wherein,

said first projected fluid path is a face normal fluid path.

59. The drill bit of claim 17, wherein,

said first projected fluid path is a parallel to nozzle centerline fluid path.

60. The drill bit of claim 17, wherein,

said first projected fluid path is a projected average fluid path.

61. The drill bit of claim 33, wherein,

said first projected fluid path is a face normal fluid path.

62. The drill bit of claim 33, wherein,

said first projected fluid path is a parallel to nozzle centerline fluid path.

63. The drill bit of claim 33, wherein,

said first projected fluid path is a projected average fluid path.

64. The drill bit of claim 1, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.5" of at least one of said cutting tips on said first cone at its closest.

65. The drill bit of claim 1, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at it closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.4" of at least one of said cutting tips on said first cone at its closest.

65. The drill bit of claim 1, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.3" of at least one of said cutting tips on said first cone at its closest.

66. The drill bit of claim 64, wherein,

said second projected fluid path is a face normal fluid path.

67. The drill bit of claim 64, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

68. The drill bit of claim 64, wherein,

said second projected fluid path is a projected average fluid path.

69. The drill bit of claim 65, wherein,

said second projected fluid path is a face normal fluid path.

70. The drill bit of claim 65, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

71. The drill bit of claim 65, wherein,

said second projected fluid path is a projected average fluid path.

72. The drill bit of claim 66, wherein,

said second projected fluid path is a face normal fluid path.

73. The drill bit of claim 66, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

74. The drill bit of claim 66, wherein,

said second projected fluid path is a projected average fluid path.

75. The drill bit of claim 17, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.5" of at least one of said cutting tips on said first cone at its closest.

76. The drill bit of claim 17, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at it closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.4" of at least one of said cutting tips on said first cone at its closest.

77. The drill bit of claim 17, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.3" of at least one of said cutting tips on said first cone at its closest.

78. The drill bit of claim 75, wherein,

said second projected fluid path is a face normal fluid path.

79. The drill bit of claim 75, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

80. The drill bit of claim 75, wherein,

said second projected fluid path is a projected average fluid path.

81. The drill bit of claim 76, wherein,

said second projected fluid path is a face normal fluid path.

82. The drill bit of claim 76, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

83. The drill bit of claim 76, wherein,

said second projected fluid path is a projected average fluid path.

84. The drill bit of claim 77, wherein,

said second projected fluid path is a face normal fluid path.

85. The drill bit of claim 77, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

86. The drill bit of claim 77, wherein,

said second projected fluid path is a projected average fluid path.

87. The drill bit of claim 33, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the tips of the cutting elements of said second cone at

their closest, said second projected fluid path being within 0.5" of at least one of said cutting tips on said first cone at its closest.

88. The drill bit of claim 33, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at it closest than to any of the tips of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.4" of at least one of said cutting tips on said first cone at its closest.

89. The drill bit of claim 33, wherein

said second projected fluid path is closer to at least one of the tips of the cutting elements of said first cone at its closest than to any of the cutting elements of said second cone at their closest, said second projected fluid path being within 0.3" of at least one of said cutting tips on said first cone at its closest.

90. The drill bit of claim 87, wherein,

said second projected fluid path is a face normal fluid path.

91. The drill bit of claim 87, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

92. The drill bit of claim 87, wherein,

said second projected fluid path is a projected average fluid path.

93. The drill bit of claim 88, wherein,

said second projected fluid path is a face normal fluid path.

94. The drill bit of claim 88, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

95. The drill bit of claim 88, wherein,

said second projected fluid path is a projected average fluid path.

96. The drill bit of claim 89, wherein,

said second projected fluid path is a face normal fluid path.

97. The drill bit of claim 89, wherein,

said second projected fluid path is a parallel to nozzle centerline fluid path.

98. The drill bit of claim 89, wherein,

said second projected fluid path is a projected average fluid path.

99. The drill bit of claim 1, wherein,

said nozzle receptacle in located in an attachable body.

100. The drill bit of claim 99, wherein,

said attachable body is welded to said bit body.

101. The drill bit of claim 17, wherein,

said nozzle receptacle in located in an attachable body.

102. The drill bit of claim 101, wherein,

said attachable body is welded to said bit body.

103. The drill bit of claim 33, wherein,

said nozzle receptacle in located in an attachable body.

104. The drill bit of claim 103, wherein,

said attachable body is welded to said bit body.

105. The drill bit of claim 1, wherein,

an at least third projected fluid path is oriented as a bit cleaning nozzle.

106. The drill bit a claim 1 wherein,

at least a third projected fluid path is oriented as a hole cleaning nozzle.

107. The drill bit of claim 2, wherein,

an at least third projected fluid path is oriented as a bit cleaning nozzle.

108. The drill bit a claim 2 wherein,

at least a third projected fluid path is oriented as a hole cleaning nozzle.

109. The drill bit of claim 17, wherein,

an at least third projected fluid path is oriented as a bit cleaning nozzle.

110. The drill bit a claim 17 wherein,

at least a third projected fluid path is oriented as a hole cleaning nozzle.

111. The drill bit of claim 18, wherein,

an at least third projected fluid path is oriented as a bit cleaning nozzle.

112. The drill bit a claim 18 wherein,

at least a third projected fluid path is oriented as a hole cleaning nozzle.

113. The drill bit of claim 33, wherein,

an at least third projected fluid path is oriented as a bit cleaning nozzle.

114. The drill bit a claim 33 wherein,

at least a third projected fluid path is oriented as a hole cleaning nozzle.

115. The drill bit of claim 34, wherein,

an at least third projected fluid path is oriented as a bit cleaning nozzle.

116. The drill bit a claim 34 wherein,

at least a third projected fluid path is oriented as a hole cleaning nozzle.

117. The drill bit of claim 3, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

118. The drill bit of claim 4, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

119. The drill bit of claim 5, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

120. The drill bit of claim 19, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

121. The drill bit of claim 20, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

122. The drill bit of claim 21, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

123. The drill bit of claim 35, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

124. The drill bit of claim 36, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

125. The drill bit of claim 37, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

126. The drill bit of claim 64, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

127. The drill bit of claim 65, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

128. The drill bit of claim 66, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

129. The drill bit of claim 75, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

130. The drill bit of claim 76, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

131. The drill bit of claim 77, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

132. The drill bit of claim 87, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

133. The drill bit of claim 88, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.

134. The drill bit of claim 89, wherein

said second projected fluid path is closer to said second set of cutting elements than to said first set of cutting elements when measured with their minimum distances.